Chapter 1 Electric and Magnetic Fields

The great thing about portable sound systems is you can take your favourite tunes virtually anywhere. Many people find this especially convenient while exercising because the music makes the whole experience more enjoyable. MP3 players are so small that they can be strapped to your arm, leaving the cord and the lightweight headphones as the only reminders that you are carrying around a complete library of all your favourite songs.

Have you ever wondered how these portable sound devices actually work? If you find it overwhelming to think of the whole system, consider just one component: the headphones. If electrical energy goes into the headphones and sound energy comes out, how is the energy conversion accomplished? If you were to carefully dissect a pair of headphones, what parts would you expect to find inside? What accounts for the difference in sound quality between inexpensive headphones and more expensive ones? Can the inappropriate use of headphones damage your hearing? Are some people more susceptible to these risks than others?

In this chapter you will investigate answers to these questions by exploring the basic properties of electric and magnetic fields. You will apply these properties as you learn about the designs of electromagnetic devices, such as headphones, motors, and generators. By the end of this chapter you will understand that all of these devices have one essential thing in common with electric circuits—their ability to convert energy from one form into another.

Try This Activity

Observing Magnetic and Electrical Effects

Purpose

You will observe and record the effects of electricity and magnetism on test objects.

Materials

- bar magnet
- ebonite rod and fur
- 1 m of thread
- retort stand and utility clamp
- 3-inch common nail
- pith ball
- tape

Procedure

step 1: Using the thread, suspend a pith ball from the retort stand, as shown in Figure C1.1.

Figure C1.1

step 2: Rub the ebonite rod several times with fur. Carefully bring the ebonite rod close to the pith ball, without allowing any contact between them. Record your observations.

step 3: Briefly touch the ebonite rod to the pith ball and then separate them. After doing so, carefully bring the ebonite rod close to the pith ball, again without allowing any contact between them. Record your observations.

step 4: Replace the pith ball with the iron nail. Suspend the nail so it is parallel to the lab bench and can swing freely from side to side, as shown in Figure C1.2.

Science Skills

- ✓ Performing and Recording
- ✓ Analyzing and Interpreting

Figure C1.2

step 5: Carefully bring a bar magnet close to the head of the nail, without touching it. Record your observations.

step 6: Briefly allow the bar magnet and the nail to touch; then separate them.

step 7: Again, carefully bring the magnet close to the pointed end of the nail, without touching it, and observe.

step 8: Hold the head of the nail and gently stroke the surface of the nail at least ten times with one end of the bar magnet. Always stroke the nail in the same direction, from the head to the point.

step 9: Bring the north end of the bar magnet to the head of the suspended nail. Record your observations.

Analysis

1. Use your observations to identify the similarities and differences between electrical effects and magnetic effects.
2. You observed forces acting between two objects even though the objects were not touching. How was this able to occur?